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# Coupling between Microstrip Lines and Finite Ground Coplanar Lines Embedded in Polyimide Layers for 3D-MMICs on Silicon

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Three-dimensional circuits built upon multiple layers of polyimide are required for constructing Si/SiGe monolithic microwave/mm-wave integrated circuits on CMOS (low resistivity) Si wafers. It is expected that these circuits will replace the ones fabricated on GaAs and reduce the overall system cost. However, the closely spaced transmission lines that are required for a high-density circuit environment are susceptible to high levels of cross-coupling, which degrades the overall circuit performance. In this paper, theoretical and experimental results on coupling and ways to reduce it are presented for two types of transmission lines: a) the microstrip line and b) the Finite Ground Coplanar (FGC) line. For microstrip lines it is shown that a fence of metalized via-holes can significantly reduce coupling, especially in the case when both lines are on the same polyimide layer or when the shielding structure extends through several polyimide layers. For closely spaced microstrip lines, coupling is lower for a metal filled trench shield than a via-hole fence. Coupling amongst microstrip lines is dependent on the ratio of line separation to polyimide thickness and is primarily due to magnetic fields. For FGC lines it is shown that they have in general low coupling that can be reduced significantly when there is even a small gap between the ground planes of each line. FGC lines have approximately 8 dB lower coupling than coupled coplanar waveguides (CPW). In addition, forward and backward characteristics of the FGC lines do not resemble those of other transmission lines such as microstrip. Therefore, the coupling mechanism of the FGC lines is different compared to thin film microstrip lines.

# PIERS 2002

Progress In Electromagnetics Research Symposium

Proceedings

July 1–5, 2002

Cambridge, Massachusetts, USA

**www.piers.org**